

PULMONARY EMBOLISM

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Sudden occlusion of a branch of the pulmonary artery makes itself manifest in several ways; notably, one in which a sudden large embolus occludes a main branch or the bifurcation (saddle embolus) of the pulmonary artery; another in which a smaller embolus causes a plugging of a smaller artery in the periphery of the lung with a resulting sudden pain, cough and hæmoptysis. The first of these may be the cause of sudden death, and is frequent enough during the second or third post-operative week to make it the bugbear of surgeons. The second is not so serious, and while it may, like the first, occur after operation, develops also in many medical conditions, especially in cardiac disease with auricular fibrillation. In this, the classic picture of pulmonary embolism, the result is too well known to need description here. Sudden, stabbing pleural pain, with an accompanying hæmoptysis, leaves little doubt as to the presence of a pulmonary infarct.

There is another type of pulmonary embolism, or, to put it more properly, there is another clinical picture, produced by sudden occlusion of a branch of the pulmonary artery that seems not so well understood. In this condition shock and dyspnœa seem to dominate the picture rather than pleural pain, cough and blood-spitting. This type of pulmonary embolism can be easily confused with coronary thrombosis, and since the treatment and prognosis are different it merits careful study. There is a well-recognized cardiac upset that follows occlusion of a pulmonary artery, the nature of which must be partly neurogenic, since the extent of pulmonary circulation affected is not sufficient to cause mechanical embarrassment of the right heart. This has been called by some *cor pulmonale acutum*, and produces a clinical picture of collapse, dyspnœa, tachycardia and cyanosis. The pain, if any, depends on the extent and location of the pleural involvement, and hæmoptysis may or may not occur.

The differentiation between coronary thrombosis and this acute *cor pulmonale* must be made on a basis of history, age, physical fitness of the patient, and other evidences of cardiac disease. As is well known, coronary thrombosis usually, though not always, occurs in a middle-aged patient with evidences of hypertension, angina or arteriosclerosis. In favour of the diagnosis of pulmonary embolism would be a young, previously healthy patient, the subject of a pelvic or abdominal operation, particularly where inflammation or trauma in the operative field had increased the likelihood of a regional phlebitis. In a coronary accident pain is more apt to be the prominent feature, where-

as in pulmonary occlusion collapse and dyspnœa dominate the picture. Hæmoptysis when it occurs early is diagnostic of pulmonary embolism, though it must be kept in mind that a pulmonary embolism can occur as a late complication of coronary thrombosis. Fever and leucocytosis are usually present in both, and so are of no help differentially. A rub occurs also in both; in coronary thrombosis it is pericardial and synchronous with the heart sounds; in pulmonary embolism it is pleural in origin, and in either it may escape detection. It is probably possible to differentiate these lesions by means of serial electrocardiograms. The changes that usually occur in coronary thrombosis are well recognized and persist for a matter of several weeks or more, whereas the typical changes that have been described as occurring in pulmonary embolism persist for only about two days. From a practical standpoint the value of the electrocardiogram is not great, since it is only available to patients in hospital and many hospitals lack this facility. In those that have an electrocardiograph it is frequently not possible or convenient to secure a tracing in the acute stage of an illness so critical as either a coronary thrombosis or pulmonary embolism. Where possible the cardiogram should be secured by all means, but we should also school ourselves to make the differential diagnosis without such aid.

Treatment consists of early administration of sufficient morphia to ensure complete relaxation and rest in either case. In pulmonary embolism papaverine, $\frac{1}{2}$ grain intravenously, may be of value. Oxygen by nasal catheter, or better by the more suitable *newer* masks, should be used where dyspnœa and cyanosis are prominent. It is in the duration of the necessary bed rest that the greatest difference between pulmonary embolism and coronary thrombosis occurs. In coronary thrombosis, as is well known, it is necessary to keep the patient in bed from six to eight weeks, while in pulmonary embolism the patient may be allowed up much sooner. Since pulmonary embolism is usually secondary to some other condition, either medical or surgical, it is usually the progress of the primary disorder that determines the duration of rest in bed.

The best treatment is, of course, prevention. In medical conditions the opportunities for preventive measures are much less than in post-operative states. It is now well recognized that the early resumption of normal respiratory activity after an operation is one effective way of lessening the danger of pulmonary complications. The use of carbon dioxide alone or in combination with oxygen during the post-anæsthetic period ensures a better degree of pulmonary ventilation. The encouragement of coughing at this early stage is also of value. Since many pulmonary emboli have their origin in a peripheral venous thrombosis the development of which is favoured by venous stasis the

early use of light massage and passive movements of the extremities is advisable. Change of position is also to be recommended for the same reason. Some surgeons have adopted the routine use of thyroid extract for their post-operative patients, on the assumption that the increased circulatory rate may help to prevent circulatory stasis. The work of the Toronto group on the intravenous use of heparin opens the fascinating possibility that we may be able to entirely avoid the danger of intravascular thromboses.

The prognosis of pulmonary embolism is al-

ways grave, and probably about one-half of all those suffering this vascular accident die. The prognosis in those who survive is fairly good. In this regard we again have an important point of difference between pulmonary embolism and coronary thrombosis. The outlook after a coronary thrombosis is always more or less uncertain, and many of these patients die from a recurrence of the coronary accident. The surgical patients who survive the initial stage of a pulmonary embolism, on the other hand, usually go on to complete recovery without much danger of another attack.

Clinical and Laboratory Notes

TRANSFUSION OF BLOOD BY AN OBSOLETE METHOD: USE OF CRILE'S CANNULA IN A CASE OF SECONDARY HÆMORRHAGE, IN 1910

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The patient, M.A., aged 20, had been cut accidentally by an adze in the leg. He was admitted to the old Toronto General Hospital, by Dr. Noble, of Sutton West, on October 14th, 1910, with a transverse wound across the calf at the junction of the lower and middle thirds of the left leg.

On October 16th, although there was no hæmorrhage, pulsation was observed above the wound over a small area, suggesting the presence of a dissecting aneurism. He was prepared for operation on October 17th, but at four o'clock on the morning of that day he had a terrific hæmorrhage. This was controlled by a tourniquet.

A vertical cut was made through the gastrocnemius and soleus muscles, exposing the divided vessels and nerve. The ends of the nerve could not be brought together; the nerve, therefore, was split longitudinally for a short distance above the point of division and a segment sufficiently long to bridge the gap was turned down and secured in position by fine chromic catgut. The artery and the vein were ligated and the torn muscle sutured. Normal saline (oz. xxv) was administered by the median basilic vein.

The wound suppurated very freely after operation and at midnight on October 24th the patient had another severe hæmorrhage which saturated the dressings. As an emergency procedure Dr. E. S. Ryerson ligated the posterior tibial artery just below the lower border of the popliteus muscle. The patient was also given normal saline intravenously. He remained in a very anæmic state, with a blood count of 2,850,000 red cells and 40 per cent Hgb. It was determined to employ blood transfusion. His brother acted as donor.

The left cephalic vein of the recipient, just above the bend of the elbow, was utilized, and the left radial artery of the donor. Anastomosis was easily accomplished by Crile's method, using his special cannula; the vein was drawn through and cuffed over the cannula and the artery drawn over that. Transfusion was continued for 15 minutes. At the end of that time the recipient showed some slight signs of dilatation of the right heart, and became somewhat restless, with marked increase in respiration. The donor's pulse became weak and slightly irregular, and had increased in rapidity from 76 to 84. He complained of feeling hot and weak. The transfusion was then stopped. The radial artery in the donor was ligated and the cephalic vein in the recipient.

The channel in which the blood flows through the cannula is very small and hence the rate of flow was slow. The only method of determining the amount of blood transfused by such a method would be, as Crile suggests, that of weighing the donor, to a fraction of an ounce, before and after the transfusion. Crile's cannulæ were supplied in various sizes; the smallest was 1.5 mm. and the largest 3 mm. in diameter. I presented a set of these cannulæ to the Academy of Medicine of Toronto as a museum specimen.

The patient made a complete recovery. A notable feature during his convalescence was the fact that subsequent to the blood transfusion the suppurating wound rapidly assumed a healthy appearance; it healed completely without any further hæmorrhage.

The record of this case is of more than academic interest. The students of today are familiar with blood transfusion as a routine procedure where it is indicated. They do not realize that this most important therapeutic measure is very modern. Less than thirty years ago it was seldom employed, and I believe the case here reported was the first one of its kind in Toronto. Crile's method was later abandoned. My first case of transfusion by the syringe method was in October, 1914.

At No. 4 Canadian General Hospital in Salonika in March, 1916, Dr. E. S. Ryerson and the writer,